
4.0 V&V STATUS AND USAGE HISTORY

This portion of ASP-I summarizes applications the model has been used to support, and the extent to which those applications have been supported by V&V documentation. Information on prior accreditations of the model is also provided in the paragraphs below.

4.1 V&V STATUS

The V&V of mission-level models in general, and SWEG in particular, must involve both the model software and the input databases. Unlike input data for engagement- or engineering-level models which are usually model configuration items, input databases for mission-level (and campaign-level) models are usually user-developed. For this reason, the primary emphasis of mission-level model V&V is on data V&V, and this can only be done when the database developer documents the sources of the data. There have been two attempts to validate mission-level models by comparing model outputs to measured field test data [9]; however, neither of those validation efforts had lasting relevance since the models changed and the databases used were not adequately configuration managed.

Our survey failed to identify any documented V&V for SWEG. It is true that software V&V has been performed by the model developer; however, this is not V&V in the sense of DODD 5000.59. Several of the contractors who are currently developing SWEG databases for subsequent analysis, including AMEWAS for JSF and ASI for the Air Force Studies and Analyses Agency (AFSAA), are concurrently documenting data sources in “pedigree” documents which can be used for subsequent V&V.

4.2 USAGE HISTORY

ACETEF Support. Historically, SWEG was first developed to serve as the real-time asset control executive for the ACETEF located at the Naval Air Station (NAS) Patuxent River, MD. ACEFTEF is comprised of a number of laboratories or facilities such as the Aircraft Anechoic Test Facility (AATF), the Manned Flight Simulator (MFS), the Electronic Warfare Integrated Systems Test Laboratory (EWISTL), and others. The ACETEF architecture is designed to support weapon system research, development, test, and evaluation, and SWEG is used to control and coordinate the various hardware assets in the different facilities. In these applications, SWEG receives input stimuli from the external hardware assets and makes other information available through the SWEDAT which is a type of shared memory.

As the interest in distributed (or virtual) simulations grew, SWEG added the capability to interface with the DIS and Defense Modeling and Simulation Office (DMSO) sponsored, HLA. SWEG was successfully used in the HLA Engineering Proto-Federation (EPF) and is expected to play an integral role in the upcoming Joint Theater Missile Defense (JTMD) and Joint Advanced Distributed Simulation (JADS) JTF projects.

Air Power versus Armored Forces Scenario Study (Battle of Khafji). SWEG is being used by AFSAA in a several-phase study sponsored by the Air Force Chief of Staff to perform in-depth analysis of airpower effects on advancing armor. Work on Phase 0 was begun in July 1995, and current effort to complete Phase 3 is underway. The study is being supported by both BDM and ASI.

The use of SWEG on this project can be broken into 6 phases: 0, I, II, II+, III, and IV. Within AFSA, this project is known as “Khafji.” A summary of each phase is as follows:

Phase 0 (Proof of Principle): Khafji required a simulation that could model both ground combat and air-to-ground airpower in constructive and virtual environments. To show that SWEG could do this, two simple scenarios were built. The first had two opposing tanks engage each other. The second added an aircraft, which detected and destroyed the enemy tank. These scenarios were run both constructively and with a DIS interface in real time.

Phase I (Representative Entities): During this phase, a variety of tactical aircraft with various weapon loads were modeled in SWEG. They attacked a threat Motorized Rifle Battalion along a road in the Khafji theater. This demonstrated that SWEG could model representative types of combatants from the battle. Digital terrain was used. This scenario was run using SWEG in both constructive and virtual modes. The air-to-ground missiles were modeled as explicit entities so they could be shown on the stealth viewer.

Phase II (Historical Recreation): The focus of this phase was to model all aircraft and their weaponry attacking an Iraqi Mechanized Division during the Battle of Khafji. This was to demonstrate that SWEG could model a sufficient quantity of entities over a multi-day battle to support future analysis. We had hoped to replicate the entire air-to-ground battle, but insufficient data on the part of the enemy's movement and attrition did not allow this. Also, the GWAPS and MISSIREF databases on airpower usage were lacking sufficient details. We were able to model the equipment and their movements for each Iraqi battalion of the Division over a 24 hour period. All aircraft from the GWAPS and MISSIREF which flew into this area was modeled as well. Constructive runs were done, with the total number of shots calibrated to GWAPS and MISSIREF. The attrition of the Iraqi ground vehicles was tallied, and conformed to one interpretation of the Army's findings. Virtual runs of various time slices were also run, with DIS Protocol Data Units (PDUs) sent to a stealth viewer. An excursion of the virtual runs was made with a B-52 dropping a large quantity of 500 pound bombs on three of the enemy battalions.

Phase II+ (Interactive SWEG): For this phase, an unclassified scenario was set up with one, three, and eight battalions modeled in tactically realistic formations within the Kuwaiti Theater of Operations (KTO). The focus was to allow for manned simulators to attack these units within a DIS environment to support various demonstrations. SWEG and its DIS interface both sent and received Entity State PDUs, and processed Detonation PDUs to destroy the ground vehicles. In addition, SWEG modeled AWACS, JSTARS, and ABCCC aircraft to add realism to the demos. The real-time Oilstock interface was used (as in Phases 0, I, and II) to provide a tactical overview of the scenario.

Phase III (Airpower Effects Simulation): This is the current phase of the project, and has emphasized data collection, enhancement of SWEG, and SWEG database construction. The plan is to use SWEG to realistically recreate the effects of airpower attacking armored forces within a multi-day battle.

Phase IV (Airpower Effects Analysis): In this phase, SWEG will be used to analyze the effectiveness of alternative airpower systems and tactics to attack advancing ground forces.

Enhancements to SWEG are being developed by BDM, in a project-specific version being called pSWEG. These enhancements include extension of graphical simulation replay

capability using Oilstock (post-processing graphical analysis, screen dump capability, capability to run Oilstock in retrieval mode); bug fixes and enhancements to resupply capability to allow explicit transfer of fuel and ordnance; and implementation of formation changes in both scripted and dynamic modes, with a relative leader following option. Other enhancements include the addition of dynamic posture change tactics, based on perceived values of some common military ratios, or on the fraction of friendly strength remaining. (Oilstock is a graphical visualization tool developed for NSA which displays a 2-D plan view of tracks obtained from either model results or from instrumented range test Time Space Position Information (TSPI) data.)

The AFSAA point of contact for this study is MAJ Daniel Clevenger.

Joint Tactical Missile Defense (JTMD). JTMD is a four-phase distributed simulation exercise designed to support baseline analysis of near-term theater missile attack. Work on the first phase was completed in July 1996. Phases 2 and 3 were completed in July 1997. The first three phases used a Southwest Asia (SWA) scenario. Phase 4 will examine a fully deployed force in a Northeast Asia (NEA) scenario, and is scheduled for completion in early 1999. The ACETEF-developed SWEG-to-DIS interface is being used for connectivity. The distributed simulation involved assets at four locations: ACETEF; the Research, Evaluation and System Analysis (RESA) facility, in San Diego, CA; the Theater Air Command and Control Simulation Facility (TACCSF), in Albuquerque, NM; and the D&SABL in Oklahoma. SWEG databases for nine scenarios have been constructed. The SWEG scenarios have approximately 2000 entities, with 600-700 of these being simulated by SWEG and the rest by other sites.

SWEG enhancements implemented for JTMD include the implementation of area effects weapons using SWEG incidental (collateral) damage, action request and action response DIS PDUs, message PDUs for JTMD contact reports, and the ability to issue entity state PDUs for dead SWEG players. The JTMD project-specific version of SWEG was named "Turquoise". The incidental damage capability was integrated into SWEG 6.5.2, released in February 1997.

Joint Strike Fighter (JSF). The JSF program is planning to use SWEG for analyses to support the JSF Joint Interim Requirements Document (JIRD) series, as well as the Joint Operational Requirements Document (JORD), and to conduct other cost and operational performance trades. The JSF program's objective is to improve weapon systems acquisition by creating an environment that "provides early interaction between the warfighter and developer to ensure cost versus performance trades are made early when they can most influence weapon system cost". JSF is working closely with candidate aircraft developers Lockheed-Martin and Boeing to evaluate a core set of models (including SWEG) and determine simulation enhancements required to use the models for analysis applications addressing issues specific to the JSF program, and ultimately, to conduct early, common (government and industry) cost-performance trade-off analyses. The JSF program plans to use SWEG for both constructive and virtual analysis efforts. Virtual applications will include SWEG linked with hardware in the loop, man in the loop, prototype aircraft, and other assets.

To support these analyses, there is an extensive model development effort underway by Bosque Technologies, funded by the JSF program, on a project-specific variant of SWEG. Changes currently being implemented include IR/RF sensor capability enhancements,

dynamic RCS capabilities, perceptions information flow to SWEG from external assets, changes to entity orientation algorithms, and several “patches”. Integration of these modifications into the baseline SWEG model will be undertaken when the completed changes are given to ACETEF by the development contractor. The ACETEF integration process will include independent integration testing.

JSF is also funding an extensive effort to develop classified input files for a Generic Composite Scenario (GCS). Distribution of these files is controlled by the Requirements Directorate at the JSF Program Office. JSF study point of contact is MAJ Robert Hartnett.

SWEG/ESAMS Interface. Also to support JSF analyses, Lockheed-Martin is developing the capability to interface SWEG with ESAMS, so that higher-fidelity missile flyout can be integrated into SWEG. It is anticipated that ESAMS’s “pedigree” will lend further credibility to SWEG results obtained using ESAMS. The current implementation uses SWEG 6.5.5 and a modified variant of ESAMS 2.7. The ESAMS modifications are scheduled for release in ESAMS 2.8. A current limitation is that each ESAMS “asset” can only control one missile at a time. This prohibits salvo firing of surface-to-air missiles (SAMs), for example. To solve this problem, the development of a “dispatcher” asset has been proposed. Requirements for additional enhancements include dynamic signature effects, correct passing of tracking radar states, passing of masking states, and countermeasures enhancements. Points of contact for this effort are Jim Smith or Tamara McNeley, at Lockheed Martin; and Ross Jones, at BDM.

4.3 IMPLICATIONS FOR MODEL USE

The lack of documented V&V and the limited use of SWEG outside ACETEF until recently are indications that SWEG has not established widespread credibility as a constructive analysis tool. Its use has been very narrowly focused as the real-time, asset control executive at ACETEF with very specific hardware interfaces. The more recent use of SWEG in constructive analyses such as the Battle of Khafji analysis by AFSAA and in JSF requirements definition will exercise more of the model’s capabilities and involve additional scrutiny of the code and algorithms and will enhance the model’s overall credibility. To date these efforts are still in database development phases, but with adequate data source documentation and disciplined model and database CM, SWEG will likely become a more widely accepted analysis tool.